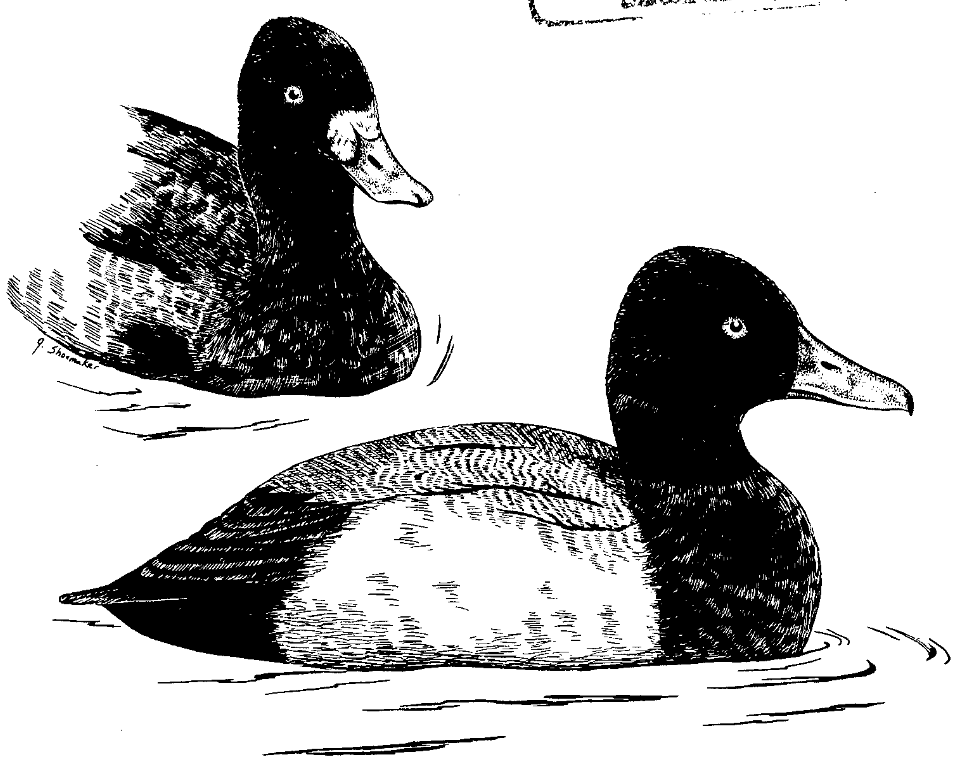
BIOLOGICAL REPORT 82(10.117)
MAY 1986

HABITAT SUITABILITY INDEX MODELS: LESSER SCAUP (BREEDING)



Fish and Wildlife Service
U.S. Department of the Interior

MODEL EVALUATION FORM

Habitat models are designed for a wide variety of planning applications where habitat information is an important consideration in the decision process. However, it is impossible to develop a model that performs equally well in all situations. Assistance from users and researchers is an important part of the model improvement process. Each model is published individually to facilitate updating and reprinting as new information becomes available. User feedback on model performance will assist in improving habitat models for future applications. Please complete this form following application or review of the model. Feel free to include additional information that may be of use to either a model developer or model user. We also would appreciate information on model testing, modification, and application, as well as copies of modified models or test results. Please return this form to:

Habitat Evaluation Procedures Group
U.S. Fish and Wildlife Service
2627 Redwing Road, Creekside One
Fort Collins, CO 80526-2899

Thank you for your assistance.

Species ______________ Geographic Location ______________________________

Habitat or Cover Type(s) ______________________________

Type of Application: Impact Analysis ____ Management Action Analysis ____
Baseline ____ Other ______________________________

Variables Measured or Evaluated ______________________________
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____
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Was the species information useful and accurate? Yes ____ No ____

If not, what corrections or improvements are needed? ______________________________
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Were the variables and curves clearly defined and useful? Yes ____ No ____

If not, how were or could they be improved? ______________________________

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Were the techniques suggested for collection of field data:

Appropriate? Yes ____ No ____

Clearly defined? Yes ____ No ____

Easily applied? Yes ____ No ____

If not, what other data collection techniques are needed? ______________

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Were the model equations logical? Yes ____ No ____

Appropriate? Yes ____ No ____

How were or could they be improved? ______________________________

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Other suggestions for modification or improvement (attach curves, equations, graphs, or other appropriate information) ______________

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Additional references or information that should be included in the model:

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Model Evaluator or Reviewer ______________________ Date ____________

Agency ____

Address ____

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Telephone Number Comm: ______________________ FTS ______________

Biological Report 82(10.117)
May 1986

HABITAT SUITABILITY INDEX MODELS: LESSER SCAUP (BREEDING)

by

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PREFACE

This document is part of the Habitat Suitability Index (HSI) Model Series [Biological Report 82(10)], which provides habitat information useful for impact assessment and habitat management. Several types of habitat information are provided. The Habitat Use Information section is largely constrained to those data that can be used to derive quantitative relationships between key environmental variables and habitat suitability. This information provides the foundation for the HSI model and may be useful in the development of other models more appropriate to specific assessment or evaluation needs.

The HSI Model section documents the habitat model and includes information pertinent to its application. The model synthesizes the habitat use information into a framework appropriate for field application and is scaled to produce an index value between 0.0 (unsuitable habitat) and 1.0 (optimum habitat). The HSI Model section includes information about the geographic range and seasonal application of the model, its current verification status, and a list of the model variables with recommended measurement techniques for each variable.

The model is a formalized synthesis of biological and habitat information published in the scientific literature and may include unpublished information reflecting the opinions of identified experts. Habitat information about wildlife species frequently is represented by scattered data sets collected during different seasons and years and from different sites throughout the range of a species. The model presents this broad data base in a formal, logical, and simplified manner. The assumptions necessary for organizing and synthesizing the species-habitat information into the model are discussed. The model should be regarded as a hypothesis of species-habitat relationships and not as a statement of proven cause and effect relationships. The model may have merit in planning wildlife habitat research studies about a species, as well as in providing an estimate of the relative suitability of habitat for that species. User feedback concerning model improvements and other suggestions that may increase the utility and effectiveness of this habitat-based approach to fish and wildlife planning are encouraged. Please send suggestions to:

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U.S. Fish and Wildlife Service
2627 Redwing Road
Ft. Collins, CO 80526-2899

CONTENTS

ACKNOWLEDGMENTS

Dr. Alan D. Afton, Mr. John T. Lokemoen, and Mr. Jean-Pierre Savard provided useful reviews of earlier drafts of the lesser scaup HSI model. The time and suggestions of these individuals are gratefully acknowledged. The cover of this document was illustrated by Jennifer Shoemaker. Word processing was provided by Dora Ibarra, Elizabeth Barstow, and Patricia Gillis. Kay Lindgren assisted with literature searches and information acquisition.

LESSER SCAUP (*Aythya affinis*)

HABITAT USE INFORMATION

General

The lesser scaup (*Aythya affinis*) is one of the most abundant ducks in North America, but information relating to its ecology is limited in comparison to that available for most other waterfowl (Rogers 1964; Trauger 1971; Hines 1977). The lack of detailed data is due, in part, to the fact that the majority of the breeding range occurs in relatively inaccessible areas of Alaska and northwest Canada (Rogers 1964) and, perhaps, to a perception that the species is highly abundant and does not face significant management problems (A. D. Afton, Minnesota Department of Natural Resources, Bemidji; letter dated January 30, 1986). The primary breeding range of the lesser scaup generally extends southeast from central Alaska to western Ontario and south to northern Wyoming and central Minnesota (American Ornithologists' Union 1983). The species will occasionally breed as far south as northeastern California, northeastern Colorado, central Nebraska, and northern Illinois. The lesser scaup has been characterized as particularly demanding of specific environmental characteristics and as the least adaptable waterfowl species in relation to changes in reproductive habitat conditions (Smith 1971).

Food

The lesser scaup feeds primarily and at times almost exclusively, on aquatic invertebrates (Rogers and Korschgen 1966). Animal foods accounted for 91% of the volume of the diet recorded on breeding grounds in Manitoba (Rogers and Korschgen 1966). Lesser scaups in Saskatchewan consumed an average of 66% animal foods and 34% vegetative material by weight during the breeding season (Dirschl 1969). Major foods included amphipods (Amphipoda), leeches (Hirudinea), waterlily (*Nymphaea* spp.), seeds, and freshwater clams (Pelecypoda). Amphipods have been identified as the most important lesser scaup food during the breeding season (Rogers and Korschgen 1966; Bartonek and Hickey 1969). The dry weight contribution of invertebrates in the lesser scaup duckling diet in Alberta was 96% (Sugden 1973). Fly (Diptera) larvae were important foods of young ducklings; older ducklings ate more amphipods. In general, lesser scaup ducklings selected the most available foods. Overall, the diet of lesser scaup ducklings was composed of 52% amphipods, 26% insects (adults and larvae), and 16% snails (Gastropoda).

Trauger (1971) concluded that food availability was more limiting to lesser scaup populations than was cover availability, due to the low productivity of the oligotrophic waters within his sub-Arctic study area.

Water

No specific information relating to the dietary water requirements of the lesser scaup was located in the literature. Water needs related to cover and reproduction are discussed in the following sections.

Cover

Lesser scaups in Alberta were more often associated with semipermanent and permanent [Type 4 and 5 wetlands as classified by Shaw and Fredine (1956)] wetlands that were ≥0.8 ha (Smith 1971). Lesser scaups relied heavily on permanent wetlands during years with lower than average precipitation. Lesser scaups were most frequently observed on semipermanent and permanent wetlands ranging from 0.85 to 2.0 ha with at least half of the shorelines bordered by trees and shrubs. Hammell (1973) recorded only 2% of 250 observations of marked lesser scaup pairs in Manitoba on temporary or intermittent ponds. Kantrud and Stewart (1977) recorded 37.8%, 52.7%, and 5.4% of breeding lesser scaup pairs on seasonal, semipermanent, and permanent wetlands, respectively, in North Dakota. Lesser scaup pair densities per/km^2 were 2.9 on seasonal wetlands, 4.7 on semipermanent wetlands, 6.1 on permanent wetlands, and 4.9 on fens. Although fens supported relatively high densities, their overall value to lesser scaups was believed to be insignificant due to their scarcity. Alkali wetlands were relatively poor for lesser scaup reproduction due to the lack of vegetative cover along their shorelines. Semipermanent wetlands were considered to be the principle breeding habitat for diving ducks and also were extremely important habitat for dabbling ducks during dry years. The number of breeding pairs of lesser scaups associated with permanent wetlands remained relatively constant between years, regardless of changing climate and water levels.

Primary habitat for lesser scaup broods has been characterized as permanent wetlands 0.85 to 2.0 ha with emergent vegetation dominating about half of the wetland (Smith 1971). Secondary brood habitat was described as semipermanent wetlands 0.4 to 0.8 ha. Broods were most often located on wetlands with wooded, or partially wooded, shorelines. The broods relied on the safety of open water rather than vegetation as protective cover. Sugden (1973) attributed a shift of lesser scaup brood use to larger permanent wetlands as a response to the the security provided by the more extensive, deep water areas. Older scaup broods regularly used wetlands that were 1.6 to 6.1 ha. Permanent ponds ≥1.6 ha were preferred brood habitat in Manitoba (Hammell 1973). Lesser scaup broods were observed only on permanent wetlands. The majority of broods moved between ponds, with an overall general direction of movement from smaller to larger ponds. Hines (1977) believed that shallow bays on the more permanent wetland types were beneficial to lesser scaup broods because they usually contained, or were lined with, emergent vegetation that provided protection from wind and wave action. Emergent vegetation provided important protective thermal cover for early age class lesser scaup broods in Manitoba (Afton 1983).

Drought, or a drop in wetland water level, during the reproductive season was considered to be the most important factor influencing lesser scaup production in Manitoba (Rogers 1959, 1964). Lesser scaup nesting behavior was strongly influenced by the withdrawal of water from emergent vegetation, which left peripheral wetland vegetation dry and isolated by mud flats. Decreased water levels were believed to result in increased nest losses from mammalian predators and decreased habitat quality due to intensified livestock grazing and encroachment of haying activities on wetland-associated vegetation. Afton (1984) also recorded lower success of lesser scaup nests in Manitoba resulting from deteriorating water conditions, which contributed to increased predation. Nest success increased with improved water conditions. Two or more years of high water conditions are believed to be required before high quality cover is established following low water periods (Rogers 1964).

Reproduction

The lesser scaup, more than any other diving duck, is prone to nest in uplands rather than over water (Bellrose 1976). The lesser scaup's preference for nesting on land, usually close to the water's edge, was recorded in Alberta (Keith 1961; Smith 1971), Saskatchewan (Hines 1977), Manitoba (Rogers 1959, 1964; Hammell 1973), and Washington (Gehrman 1951). Fifty percent of the lesser scaup nests located in a Saskatchewan study were within 5.0 m of the water's edge, whereas 75% were within 10 m (Hines 1971). Nest sites were usually on dry ground and at least 30 cm above water level. Rogers (1964) recorded an average distance from lesser scaup nests to water of 2.1 m during years with normal water level. The maximum distance from water to a nest was 13.7 m. More than 50% of the nests recorded by Gehrman (1951) in Washington and >98% of those recorded by Keith (1961) in Alberta were within 4.5 m of water. The mean distance from lesser scaup nests to water in Manitoba was 13.0 ± 0.9 m (Hammell 1973). Although most lesser scaup nests are in close proximity to water, they have been found up to 0.4 km from water (Afton, unpubl.).

Smith (1971) described sedge (Carex spp.)-dominated marshes that were 80% to 90% covered by emergent vegetation as the most suitable lesser scaup nesting cover. Since lesser scaups nest primarily on land, the disappearance of emergent vegetation was not believed to be a serious deterrent to their nesting. Lesser scaup populations did decrease rapidly when terrestrial vegetation surrounding semipermanent and permanent wetlands deteriorated. The most commonly utilized nest cover in Washington was reed canarygrass (Phalaris arundinacea) and rushes (Juncus spp.) at the water's edge (Gehrman 1951). Grasses were the dominant vegetative cover (67%) surrounding lesser scaup nests in Saskatchewan, whereas shrubs (20%) and forbs (13%) were the dominant cover for the remaining nests (Hines 1977). Extremely dense forb cover composed of common nettle (Urtica gracilis) and Russian pigweed (Axyris amaranthoides) appeared too tall and dense for lesser scaup nest establishment. The edges of such cover, however, were used for nesting. Seventy-eight percent of the lesser scaup nests located were in vegetation that ranged from 21.0 to 60.0 cm in height. Vegetation <20.0 cm tall was avoided. Nests in vegetative cover >60.0 cm tall typically were associated with the edges of particularly dense herbaceous cover. The majority of lesser scaup nests in a Washington study were within grass/forb vegetation that ranged from 25.4 to 63.6 cm in

height (Gehrman 1951). The average canopy coverage at 57 lesser scaup nests in Saskatchewan was 35.7% ± 3.6% (Hines 1977). Ninety-two percent of the lesser scaup nests located in an Alberta study were in vegetation that concealed ≥50% of the nest from above (Dwernychuk and Boag 1972).

Lesser scaups prefer to establish nests on islands (Giroux 1981) and points of land in lakes and deep marshes (J. T. Lokemoen, Northern Prairie Wildlife Research Center, U.S. Fish and Wildlife Service, Jamestown, North Dakota; letter dated August 13, 1985). Reproductive success of island-nesting lesser scaups is high (Keith 1961; Townsend 1966; Vermeer 1968; Long 1970 cited by Hines 1977). The provision of suitable island nesting habitat is a recommended management practice for lesser scaups, since their nests are often destroyed by predators in upland habitats (Keith 1961; Rogers 1964). Hammell (1973), however, recorded low nest success for lesser scaup on small islands that were close to shore, due to predation by mink (Mustela vison). Greatly increased mammalian predation on scaup nests in Manitoba was attributed to the desiccation of grass/sedge cover adjacent to wetlands due to drought and decreasing water levels (Rogers 1959, 1964). Lesser scaups are highly susceptible to nest predation because of their tendency to nest near the edge of water and the foraging behavior of mammalian predators to thoroughly search such vegetation. Lesser scaup nest losses to predators were greater for nests that were <7.6 m from water than those >7.6 m from water (Keith 1961). Lower success for lesser scaup nests in close proximity to water compared to nests at greater distances from water also was recorded in Manitoba (Hammell 1973).

Kalmbach (1937, cited by Rogers 1964) speculated that lesser scaups seldom attempt to renest because they are relatively late nesters; most renesting occurs too late to enable young to fly before freeze-up. The proportion of lesser scaup hens that renested in Manitoba tended to increase with improved habitat conditions (e.g., number of wetlands, less fluctuation in water level) (Afton 1984).

Interspersion

Lesser scaups have relatively small, highly overlapping home ranges (Hammell 1973; Afton unpubl.). The mean minimum home range for lesser scaups in Manitoba was 89.0 ± 6.5 ha (Hammell 1973).

HABITAT SUITABILITY INDEX (HSI) MODEL

Model Applicability

Geographic area. This model was developed for application in the breeding range of the lesser scaup within the conterminous United States (Figure 1).

Season. This model was developed to evaluate the quality of reproductive habitat for the lesser scaup.

Cover types. This model was developed for application in the following cover types (terminology follows that of U.S. Fish and Wildlife Service 1981): Herbaceous Wetland (HW), and Lacustrine (L).

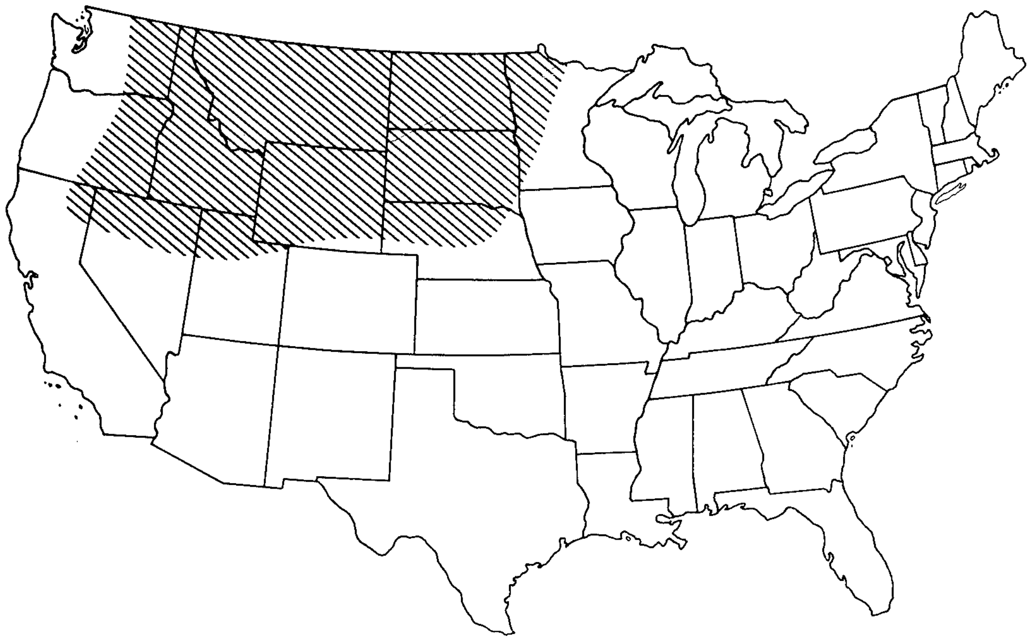

Figure 1. Approximate distribution of lesser scaup primary breeding range in the conterminous United States (modified from Bellrose 1976).

Lesser scaups are primarily dependent upon permanent and semipermanent herbaceous wetlands to provide their reproductive habitat requirements. Wetlands that maintain surface water for all or the majority of the year have been classified by Shaw and Fredine (1956) as Type 4 and 5 wetlands. Stewart and Kantrud (1971) classified wetlands with continuous, or nearly continuous, water presence as permanent and semipermanent wetlands. A more contemporary wetland classification system (Cowardin et al. 1979) described wetlands of these types as permanently flooded or intermittently exposed and semipermanently flooded. Although any wetland classification system may be used, the terminology and description of wetlands types in the lesser scaup model follow that of Cowardin et al. (1979).

Minimum habitat area. Minimum habitat area is defined as the minimum amount of contiguous habitat that is required before an area will be occupied by a species. Specific information on the minimum habitat area required by the lesser scaup was not located in the literature. Nesting and brood requirements of the lesser scaup demand the presence of permanently flooded, intermittently exposed, and semipermanently flooded wetlands. It is assumed that wetlands with these water regimes, regardless of size, have the potential to provide the lesser scaup's reproductive habitat requirements.

Verification level. This HSI model provides habitat information useful for impact assessment and habitat management. The model is a hypothesis of species-habitat relationships and does not reflect proven cause and effect

relationships. Earlier drafts of this model were reviewed by Dr. Alan D. Afton, Minnesota Department of Natural Resources, Bemidji, MN; Mr. John T. Lokemoen, Northern Prairie Wildlife Research Center, Jamestown, ND; and Mr. Jean-Pierre Savard, Canadian Wildlife Service, Delta, British Columbia.

Model Description

Overview. Although use of seasonally and temporarily flooded wetlands for nesting has been recorded, the majority of lesser scaup nests have been located at the water's edge, or in close proximity to permanently flooded, intermittently exposed, and semipermanently flooded wetlands. In contrast to other diving ducks, lesser scaups seldom nest over water in emergent vegetation. In addition, lesser scaup broods are not highly dependent on an abundance of emergent vegetation since their brood cover requirements are generally met by the presence of open water in permanently flooded wetlands. The majority of lesser scaup nests have been recorded within 10 m of the water's edge. Nest success is greater for nests that are located farther from water. Although wetland complexes (i.e., a diversity of wetland classes and sizes in relatively close association) provide a variety of feeding and loafing sites, and probably represent habitats that can produce maximum numbers of lesser scaups, permanently flooded, intermittently exposed, and semipermanently flooded wetlands must be present to provide preferred lesser scaup reproductive habitat.

Smith (1971) concluded that wetland size, water permanence, the availability of hydrophytic vegetation, and land use adjacent to wetland basins all have an influence on duck behavior and habitat use. These factors are, in turn, directly affected by annually fluctuating precipitation patterns. Therefore, the formulation of effective waterfowl habitat management plans must be structured around average habitat conditions, since attempts to manage habitat in response to specific annual conditions would result in management problems of impossible proportions.

This model is based on the assumption that permanently flooded, intermittently exposed, and semipermanently flooded wetlands provide key reproductive habitat for lesser scaups during years of normal, or below normal, precipitation. Although seasonally flooded wetlands may have increased reproductive habitat potential for the species during years of above average precipitation, the potential of seasonally flooded, or less permanent, wetlands is not addressed in this model. This model is based on the assumption that adequate nesting and brood habitat will be more limiting than food availability within the lesser scaup's breeding range in the conterminous United States. Therefore, food availability is not included as a component of this model.

The following sections provide documentation of the logic and assumptions used to translate habitat information for the lesser scaup to the variables and equation used in the HSI model. Specifically, these sections identify important habitat variables, define and justify the suitability levels of each variable, and describe assumed relationships between variables.

Nesting component. Lesser scaups typically establish nests within vegetative cover in close proximity to permanently flooded, intermittently exposed, and semipermanently flooded wetlands. The majority of nests reported in the literature were within 10 m of water. Lower nest success has been recorded for lesser scaup nests that are near the water's edge relative to nests situated farther from water. This model is based on the assumption that required wetland types surrounded by a relatively wide band of relatively tall, dense vegetative cover represent habitat of greatest reproductive potential. Therefore, this model is based on the evaluation of vegetative conditions within a 50 m zone around permanently flooded, intermittently exposed, and semipermanently flooded wetlands. Although vegetative cover outside of the 50 m zone may be used, it is assumed to have no reproductive habitat potential for the species and is not addressed in this model.

This model evaluates nesting suitability as a function of three variables: (1) percent herbaceous canopy cover, (2) average height of herbaceous vegetation during the primary nest initiation period (typically June throughout most of the lesser scaup's breeding range), and (3) percent shrub crown cover. Suitability of habitat as nest cover as defined by these habitat attributes is assumed to reflect observed preferences for nesting female lesser scaups as measured by nest density.

Nesting habitat for lesser scaups is centered around permanently flooded, intermittently exposed, and semipermanently flooded wetlands. Relatively tall and dense herbaceous vegetation in close proximity to these wetlands provides preferred nest cover and apparently supports the highest density of lesser scaup nests. Conversely, extremely short or sparse vegetative cover reflects poor cover conditions that support extremely low nest density and represents little to no suitability as lesser scaup nesting habitat. The most preferred nesting habitat for lesser scaup is assumed to occur when a 50 m zone surrounding permanently flooded, intermittently exposed, and semipermanently flooded wetlands supports 30% to 75% canopy cover of herbaceous vegetation (Figure 2a), ranging from 25 to 61 cm in height in June (Figure 2b). Vegetative cover that is sparse (<30% canopy cover) or extremely short (<25 cm in height) during the nesting season is assumed to be inferior nesting habitat for lesser scaups. Lesser scaups also have been reported to avoid extremely dense and tall herbaceous vegetation for establishment of nests. Therefore, herbaceous canopy cover >75% is assumed to represent nesting habitat of lower suitability. Even extremely dense (>75%) and high (>61 cm) herbaceous vegetation is assumed to have some potential as reproductive habitat, since lesser scaups will nest in the edge of such cover.

The presence of shrubs can enhance nesting habitat suitability when present at densities ranging from 10% to 25% in the 50 m zone surrounding permanently flooded, intermittently exposed, and semipermanently flooded wetlands (Figure 2c). Nesting cover suitability is assumed to decrease as shrub cover increases above 25% because of decreasing availability of preferred herbaceous vegetation. Areas that are totally dominated by shrubs (>80% crown cover) are assumed to provide nesting habitat of minimum potential. The complete absence of shrubs is assumed to not limit an area's potential as nesting habitat if suitable herbaceous vegetation is available.

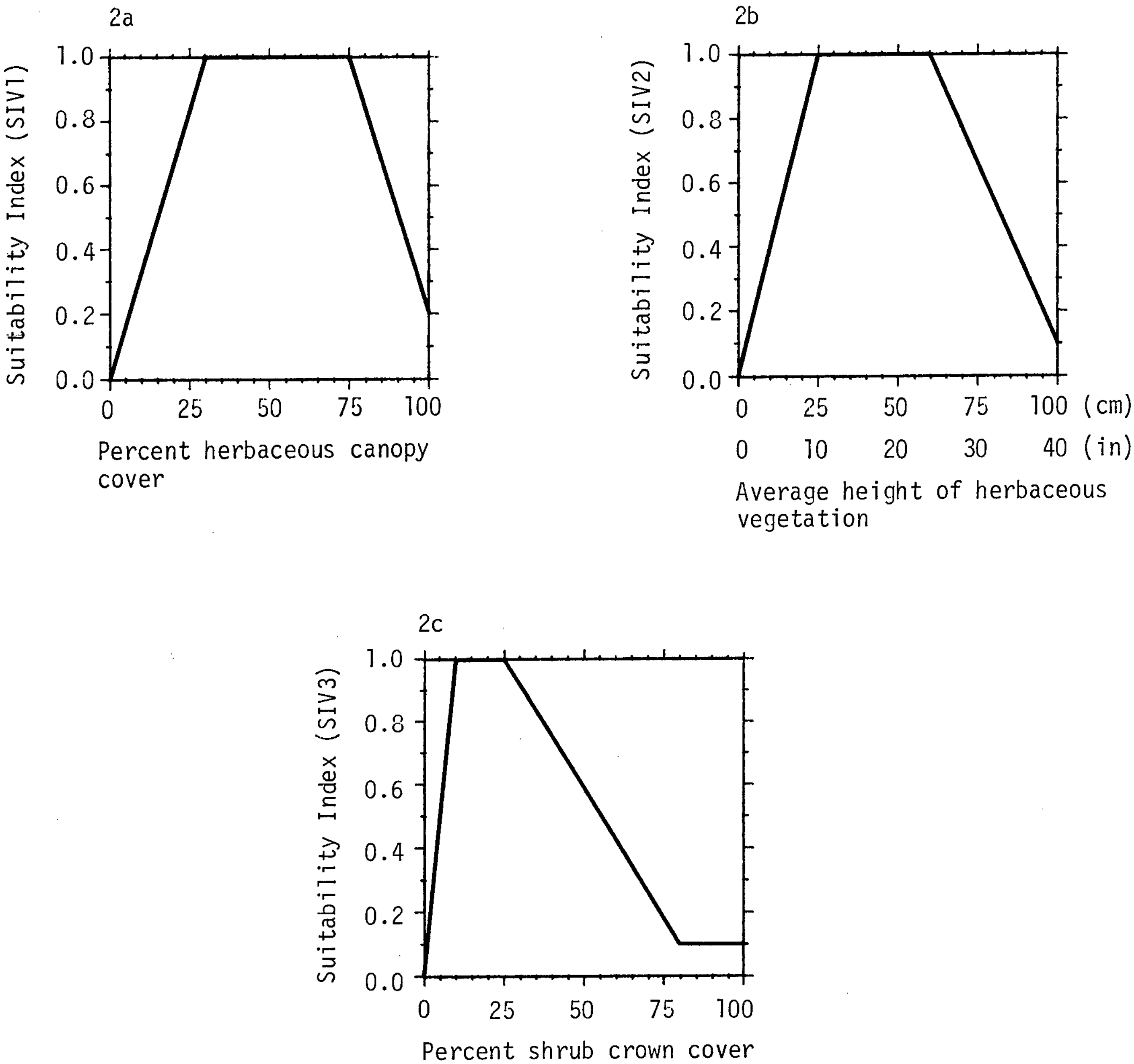

Figure 2. The relationships between values for habitat variables used to evaluate lesser scaup nesting habitat and suitability indices for the variables.

Density (SIV1) and height (SIV2) of herbaceous vegetation within a 50 m zone surrounding permanently flooded, intermittently exposed, and semipermanently flooded wetlands are assumed to be the most influential characteristics defining nesting habitat suitability for the lesser scaup. Sparse stands of herbaceous vegetation may be compensated for by vegetation of optimum height (25 to 61 cm). Conversely, dense herbaceous vegetation will compensate for vegetation of suboptimum height. Shrubs (SIV3) can enhance nesting habitat potential for the species; however, the presence of shrubs is assumed to have less potential for providing suitable nesting habitat than does preferred herbaceous cover.

The assumed relationship between herbaceous vegetation and shrubs, and the suitability of nesting habitat (SIN) is expressed in equation 1.

$$SIN = \frac{3(SIV1 \times SIV2)^{1/2} + SIV3}{4} \qquad (1)$$

Brood component. Ideal lesser scaup brood habitat is provided by permanently flooded and intermittently exposed wetlands (Figure 3a). Wetlands of these types contain open surface water in all years except those of extreme drought. Open water within these wetland types provides security and escape cover required by lesser scaup broods. Semipermanently flooded wetlands normally contain surface water throughout the growing season. When considered on a long-term basis, however, semipermanently flooded wetlands have less potential as brood habitat for lesser scaups, due to the less permanent nature of surface water in these basins and their relatively small size when compared to permanently flooded and intermittently exposed wetlands. Seasonally, temporarily, and intermittently flooded wetlands are assumed to have no value as lesser scaup brood habitat, due to their lack of surface water throughout the breeding season.

Lesser scaup broods tend to use expansive areas of open water for security and escape cover to a greater extent than the structural cover provided by wetland-associated vegetation. Emergent vegetation is used by young age class broods as protective cover from weather and wave action as well as escape cover. Lesser scaups occasionally utilize emergent vegetation for the establishment of nest sites; however, when its use for nesting is compared to that of upland nest sites, emergent vegetation is relatively unimportant. Therefore, it is assumed in this model that the presence and density of emergent herbaceous vegetation has a greater influence in defining brood habitat conditions than nesting cover habitat quality. Permanently flooded, intermittently exposed, and semipermanent wetlands that support 20% to 50% canopy cover of emergent herbaceous vegetation are assumed to represent habitats that would support maximum densities of lesser scaup broods (Figure 3b). Habitat suitability for lesser scaup broods is assumed to decrease as the proportion of the wetland basin dominated by emergent vegetation exceeds 50%. As the extent of emergent vegetation increases, the amount of open water is assumed to decrease, resulting in less open water that is required for security and escape cover. Wetlands totally dominated by emergent herbaceous vegetation are assumed to represent unsuitable brood habitat. Wetlands devoid of emergent herbaceous vegetation are assumed to be indicative of less than ideal brood habitat due to the absence of cover suitable for use by young age class broods.

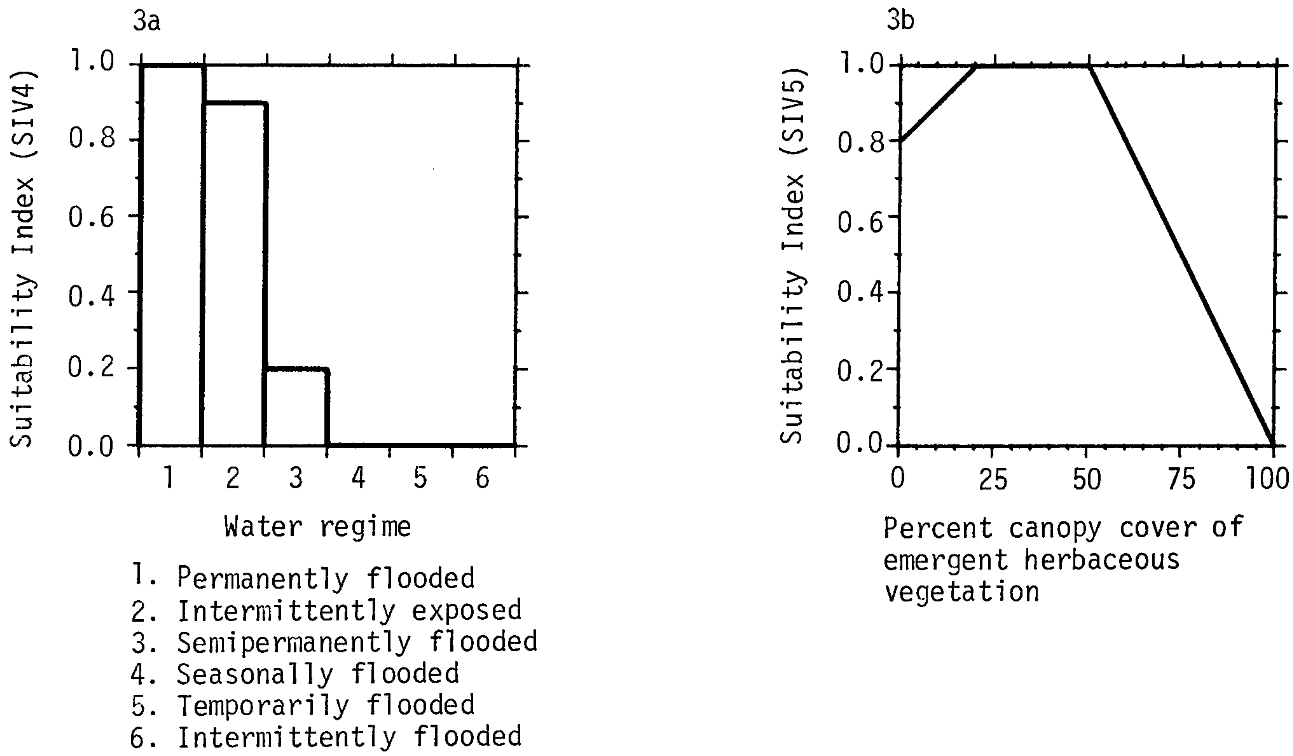

Figure 3. The relationships between values for habitat variables used to evaluate lesser scaup brood habitat and suitability indices for the variables.

The assumed relationships between wetland water regime (SIV4) and the abundance of emergent herbaceous vegetation (SIV5) and the influence of these variables on the suitability of lesser scaup brood habitat (SIB) are expressed in equation 2. Lesser scaup broods use extensive open water as escape cover to a greater degree than the protection provided by emergent vegetation. Therefore, the influence of water regime is assumed to be more important than the presence of emergent vegetation in defining brood habitat potential and is weighted in the equation to reflect this assumption.

$$SIB = (SIV4 \times SIV5^2)^{1/3} \qquad (2)$$

<u>HSI determination.</u> The calculation of an HSI for the lesser scaup considers only the life requisite values calculated for nesting and brood habitat. The HSI for the lesser scaup is equal to the lowest value calculated for either life requisite.

Application of the Model

Summary of model variables. Five habitat variables are used in this model to evaluate reproductive habitat quality for the lesser scaup. The relationship between habitat variables, cover types, life requisites, and HSI are summarized in Figure 4. Definitions of variables and suggested measurement techniques (Hays et al. 1981) are provided in Figure 5.

The water regime modifiers that are used in this model (Figure 3a) are described below (Cowardin et al. 1979:24).

Permanently flooded. Water covers the land surface throughout the year in all years. Vegetation is composed of obligate hydrophytes.

Intermittently exposed. Surface water is present throughout the year except in years of extreme drought.

Semipermanently flooded. Surface water persists throughout the growing season in most years. When surface water is absent, the water table is usually at or very near the land surface.

Seasonally flooded. Surface water is present for extended periods especially early in the growing season, but is absent by the end of the season in most years. When surface water is absent, the water table is often near the land surface.

Temporarily flooded. Surface water is present for brief periods during the growing season, but the water table usually lies well below the soil surface for most of the season.

Intermittently flooded. The substrate is usually exposed, but surface water is present for variable periods without detectable seasonal periodicity.

Model assumptions. Determination of a nesting value for the lesser scaup is based on the quality of vegetative cover around permanently flooded and intermittently exposed wetlands. The majority of lesser scaup nests are at, or very near, the water's edge. Success rate of these nests, however, has been reported to be relatively low when compared to the success rate of nests situated further away from the water. Therefore, application of the nonwetland variables is based on the evaluation of vegetative cover within a 50 m zone around permanently flooded and intermittently exposed wetlands. The selection and use of a 50 m zone surrounding permanently flooded and intermittently exposed wetlands is based on the assumption that this amount of area will provide suitable reproductive habitat if adequate vegetative conditions are present. The literature, however, does not identify a 50 m zone as being required by the species, only that the majority of nests are in close association to the wetland edge and nest success increases as nest distance from water increases. The model user may wish to modify this zone to evaluate vegetative conditions adjacent to permanently flooded/intermittently exposed wetlands based on local conditions or data.

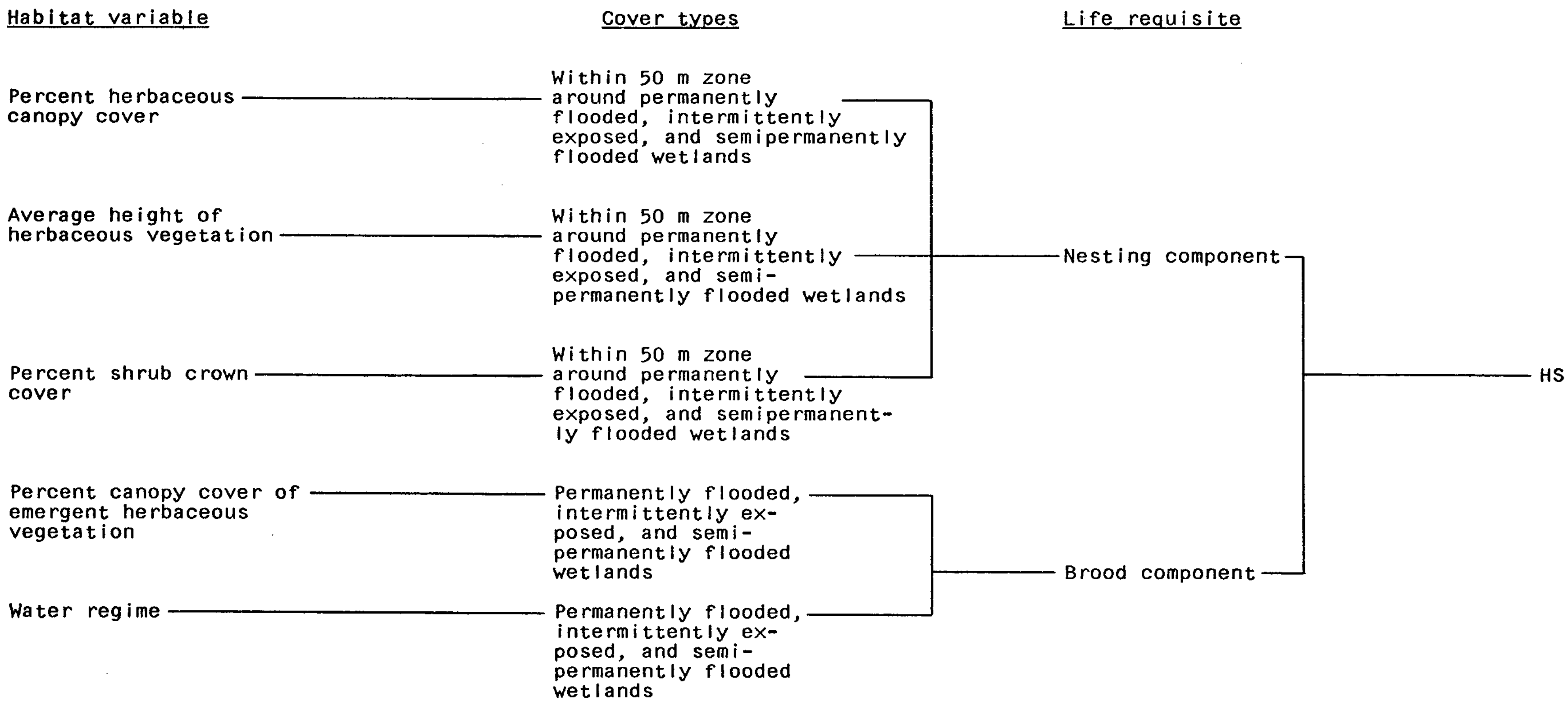

Figure 4. Relationships of habitat variables, cover types, and life requisites in the lesser scaup HSI model.

Variable (definition)		Cover types	Suggested technique
V1	Percent herbaceous canopy cover [the percent of the ground surface that is shaded by a vertical projection of all nonwoody vegetation (grass, forbs, sedge, etc.)].	Within 50 m zone around permanently flooded, intermittently exposed, and semipermanently flooded wetlands.	Line intercept, quadrat
V2	Average height of herbaceous canopy in June (the average vertical distance from the ground surface to the dominant height stratum of the herbaceous vegetative canopy).	Within 50 m zone around permanently flooded, intermittently exposed, and semipermanently flooded wetlands.	Line intercept, quadrat
V3	Percent shrub crown cover [the percent of the ground surface that is shaded by a vertical projection of the canopies of woody vegetation <5 m (16.5 ft)].	Within 50 m zone around permanently flooded and intermittently exposed wetlands	Line intercept, quadrat
V4	Percent canopy cover of emergent herbaceous vegetation [the percent of the water surface shaded by a vertical projection of the canopies of emergent herbaceous vegetation (both persistent and nonpersistent)].	Permanently flooded, intermittently exposed, and semipermanently flooded wetlands.	Remote sensing, line intercept
V5	Water regime (the permanence of water in a wetland defined by Cowardin et al. 1979. See text for definitions).	Permanently flooded, intermittently exposed, and semipermanently flooded wetlands.	Remote sensing, cover-type map

Figure 5. Definitions of variables and suggested measurement techniques.

The nesting component of this model is to be applied to a 50 m zone around permanently flooded, intermittently exposed, and semipermanently flooded wetlands only. The brood component is to be applied to these wetland types as well. The weighting factors for these three wetland types, reflecting nesting and brood values, will vary based on expected water permanence within the basins.

SOURCES OF OTHER MODELS

Mulholland (1985) has developed an HSI model applicable to the evaluation of lesser scaup wintering habitat associated with the Gulf of Mexico and the southern Atlantic coasts. The model is applicable in estuarine, marine, and palustrine habitats. No other habitat models for evaluation of breeding habitat for the lesser scaup were located in the literature.

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16. Abstract (Limit: 200 words)

A review and synthesis of existing information were used to develop a Habitat Suitability Index (HSI) model for the lesser scaup (Aythya affinis). The model consolidates habitat use information into a framework appropriate for field application, and is scaled to produce an index between 0.0 (unsuitable habitat) and 1.0 (optimum habitat). HSI models are designed to be used with Habitat Evaluation Procedures previously developed by the U.S. Fish and Wildlife Service.

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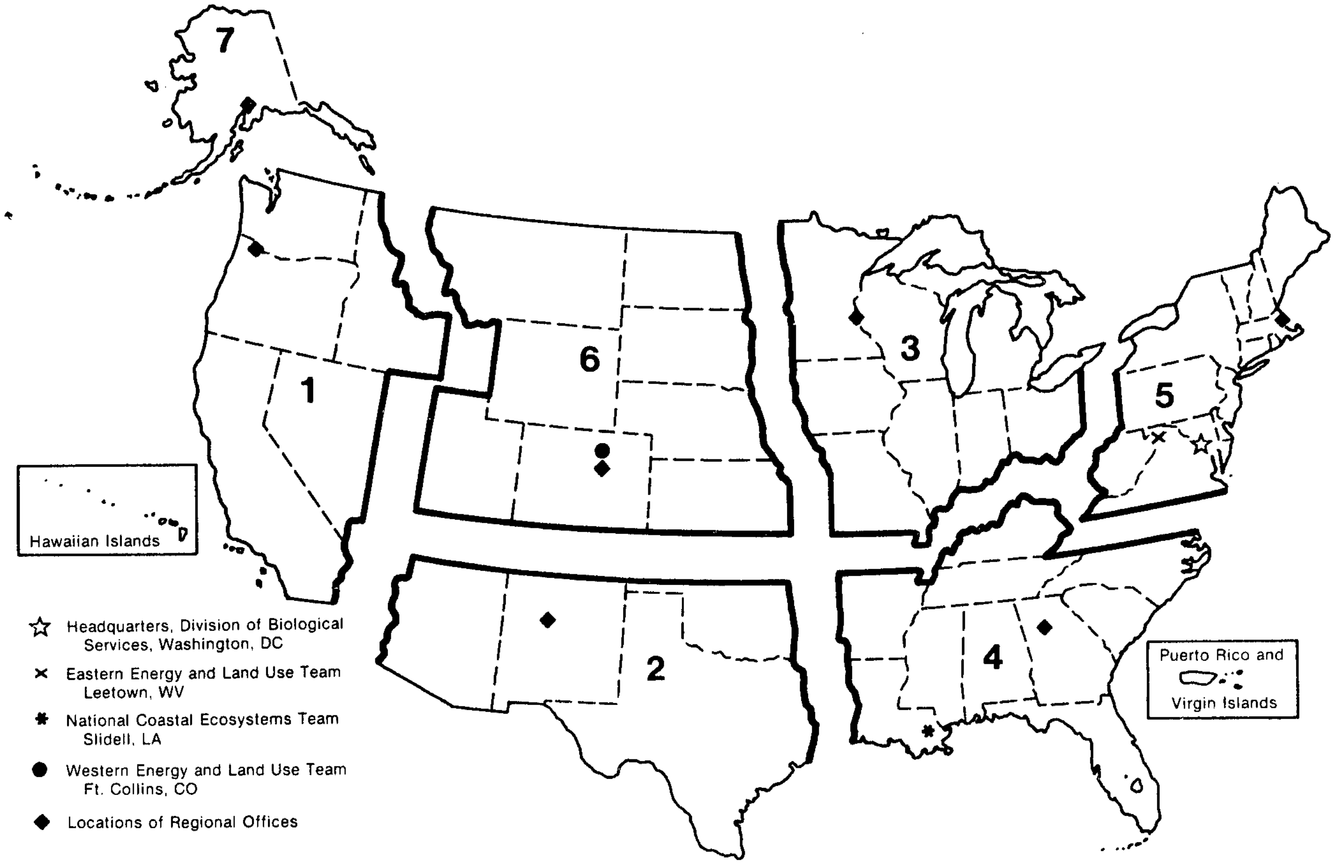

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